FAA-C-2817
October 20, 1987

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
SPECIFICATION

CONSTRUCTION OF SMALL PRE-CAST CONCRETE BUILDING

FOR ELECTRONIC EQUIPMENT

TC/01

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1-1 SUMMARY OF WORK

1-1.1 General.- These specifications, together with the referenced specifications, standards and drawings specified in the Contract Documents, cover the requirements of the Federal Aviation Administration, hereinafter referred to as the Government or FAA, for all work associated with the construction of a small precast concrete building to house electronic equipment.

1-1.2 Scope.- The work includes the construction of a 10-foot by 14-foot small precast concrete equipment shelter including concrete foundation; electrical work and air-conditioner; installation of access driveway and parking area (fenced area) to include grading, subgrade compaction, and installation and compaction of fill material and surface course; grading and compaction of plot area; installation of facility grounding system and the construction and installation of appurtenances to the foregoing as specified and indicated by the drawings or required by the FAA standard specifications which are a part of this contract.

1-1.3 Intent of specifications.- This specification identifies all labor, materials, plant and equipment to perform the work required to construct the facility. All work performed and all materials and equipment used shall be subject to the approval of the Contracting Officer Representative (COR). This shall include, but not be limited to, testing, inspection, scheduling, reporting, and submittals.

1-1.4 Contract documents.- Documents identified in Attachment 2 of Part III, Section J, as Drawings for the Site Work, Architectural, Structural, Mechanical, and Electrical form a part of the construction requirements for this project.

1-1.4.1 Construction per drawings.- The construction of this facility shall be in accordance with the lines shown on the drawings. The contractor shall not use dimensions scaled from drawings.

1-1.5 Precedence of contract documents.- In the event of a difference between the following contract provisions, the order of precedence to determine which provision shall govern is as follows:

Section H - Special Contract Requirements
Project Specifications, FAA-C-2817, Section J, Attachment 1
Project Drawings, Section J, Attachment 2

Any discrepancies between the contract provisions, the specifications and the contract drawings shall be referred to the COR for a written determination in accordance with FAR 52 236-21, Specification and Drawings for Construction (April, 1984).

1-1.6 Document sources.-

1-1.6.1 Federal specifications.- The federal specifications and standards, and supplements, amendments, and indices thereto are prepared and issued by the General Services Administration of the Federal Government. They may be obtained from the Specifications Activity, Printed Materials Supply Division, Building 197, Naval Weapons Plant, Washington, D. C. 20407.

1-1.6.2 Publications.- Drawings are available for review at the FAA regional offices.

Copies of military documents may be obtained from the Commanding Officer, Naval Supply Depot, 6801 Tabor Avenue Philadelphia, Pennsylvania 19120, Attention: Code CDS.

Information on obtaining copies of federal specifications and standards may also be obtained from General Services Administration offices in Atlanta; Boston; Chicago; Denver; Fort Worth; Houston; Kansas City, MO.; Los Angeles; New York; Philadelphia; San Francisco; Seattle; and Washington, D. C..

Copies of Illuminating Engineering Society documents can be obtained from the Illuminating Engineering Society, 345 East 47 Street, New York, New York 10017.

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1-2 SITE ACCESS, CONSTRUCTION LIMITS, USE OF FACILITIES AND WORK HOURS

1-2.1 General.-

1-2.1.1 Existing facility operations.- For construction on or in the immediate vicinity of an airport, it will be necessary to coordinate all construction activity so as not to interfere with the functions of the airport. The contractor shall perform all work with a minimum disruption to the FAA and airport operations. Any work performed within 500 feet of any active runway may require its closing. Advance notice of at least 24 hours of proposed work near an active runway must be given to the COR. All work shall be coordinated with the Airport Manager, Airport Traffic Control Tower, Airport Security and other contractors through the COR.

1-2.1.2 Construction limits and access.-

1-2.1.2.1 Construction limits.- The contractor shall confine operations, activities, storage of materials and employee parking within the designated areas, as indicated on the construction staging plan. Additional space the contractor deems necessary shall be obtained off site, at no additional cost to the Government.

1-2.1.2.2 Access to site.- Access to the site shall be as indicated on the drawings. The contractor shall maintain the security integrity of the site at all times. Any existing access roads including surface course, grading, and erosion protection shall be maintained by the contractor throughout the Contract term and be brought to "as-new" condition at the time of final inspection.

1-2.1.2.3 Damage to site.- Damage to existing paving, lawns, curbs, or sidewalks, caused by the contractor's activities shall be repaired. All costs of repairs shall be paid by the contractor. After notice to proceed and prior to the commencement of construction, the contractor and COR shall conduct joint inspections of the existing areas affected by the construction. Existing damage or defects shall be noted and will be used as the basis for determination of damages caused by the contractor's operations.

1-2.1.3 Inspection of site by contractor.- The contractor shall have carefully examined the premises to determine the extent of work and the conditions under which it must be done. On request to the COR, the contractor may obtain permission to make soil borings or probings.

1-2.1.4 Contractors' use of premises.-

1-2.1.4.1 Contractor shall have complete and exclusive use of the premises within the construction staging area limits for the execution of the work.

1-2.1.4.2 Contractor shall assume full responsibility for the protection and safekeeping of products stored on the site.

1-2.1.4.3 The contractor and subcontractors shall maintain the job site in a neat and orderly condition. This includes the daily removal of rubbish, waste and tools, equipment and materials not required for the work in progress.

1-2.1.5 Government use and access to premises.- The Government reserves the right to enter the premises during the term of the contract for periodic work inspections. See Part I, Section F, FAR Clause 52.236-8 "Other Contracts" for work by other contractors.

1-2.1.6 Security requirements.-

1-2.1.6.1 Personnel list.- Contractor shall provide the COR with a list of contractor's personnel who will require access to the site. The list shall be kept current during project work. In the case of construction which takes place on an airport, the contractor shall provide all personnel with readily identifiable numbered badges during the period their access to the site is required. Badges shall be shown to the FAA security guard to enter the site, and shall be worn on outer clothes while at work in the site.

1-2.1.6.2 Security investigation.- Contractor's personnel may be subject to security investigation by FAA. Upon request by the COR, the contractor shall promptly complete all security forms provided by the COR.

1-2.1.6.3 Communication.- The contractor will be required to have radio-equipped vehicles for communications with the air traffic control tower while working in controlled airport operation areas.

1-2.1.6.4 Right to search.- Current procedures at FAA facilities located within airport boundaries include the "right to search." If in the judgement of the authorized security guard a cause to search a vehicle or the person of personnel exists, such search will be made.

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1-3 COORDINATION, LOCAL PERMITS AND TESTING

1-3.1 General.-

1-3.1.1 Project coordination.- The contractor shall prepare a detailed schedule of work and work layout to resolve conflicts and to ensure coordination of the work by different trades. It shall be the duty of the contractor to resolve all coordination conflicts that arise among his subcontractors.

1-3.1.2 Local permits.- The contractor shall apply, pay fees, to obtain local building permits and inspection as required. See Part I, Section F, FAR Clause 52.236-7 for additional information.

This building is designed in accordance with the Uniform Building Code, the Uniform Plumbing Code, and the National Electrical Code. The contractor shall construct the building in compliance with these codes.

1-3.2 Applicable documents.- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

1-3.2.1 American Association of State Highway and Transportation Officials (AASHTO).-

T99	Moisture Density Relations of Soils Using a 5.5-Pound Rammer and 12-Inch Drop.
T191	Density of Soil in-Place by the Sand-Cone Method
T205	Density of Soil in-Place by the Rubber Ballon Method
T238	Density of Soil and Soil Aggregate by Nuclear Method (Shallow Depth)
M145	Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes

1-3.3 Testing.-

1-3.3.1 Contractor's responsibility.- Cooperate with the testing laboratory and make available, without cost, samples of all materials to be tested. Contractor shall furnish such normal labor as is necessary to obtain samples at the project site and to assist in making slump tests, casting and curing concrete cylinders. Contractor shall advise the testing laboratory of the identity of material sources and instruct these suppliers to allow inspections by the laboratory representatives, and notify the testing laboratory sufficiently in advance of operations to allow for completion of initial tests and assignment of inspection personnel.

1-3.3.1.1 Selection and payment.- The Contractor shall select and pay for a qualified testing laboratory or laboratories to perform the requirements of this section.

1-3.3.1.2 Rejected materials or workmanship.- All materials or workmanship or both which have been rejected by the COR by reasons of failure to conform to the requirements of the Contract Documents shall be removed and replaced with new, acceptable materials by the contractor at contractor's own expense. Contractor shall pay for testing of new materials which have been installed in place of rejected materials.

1-3.3.2 Test reports.- The testing laboratory shall furnish three copies of each report direct to the COR covering all of its determinations and all of its control services. Reports shall show all data customarily listed by the laboratory in reporting on quantities, qualities, and types of materials, together with their location in the project and applicable Specification Section. Form of reports shall be acceptable to the COR.

1-3.3.3 Testing procedures.-

1-3.3.3.1 General.- Initial soil borings, testing and resultant soil classifications will be accomplished by the FAA and copies of test results will be available in the COR's office. All subsequent testing for borrow material compaction and concrete shall be the responsibility of the Contractor. The FAA reserves the right to direct retesting in the event of failures and any retesting shall be at Contractor's expense.

1-3.3.3.2 Earthwork testing-.

1-3.3.3.2.1 Maximum density.- The maximum density of the soil types at the site or borrow material approved for use on this project shall be determined in accordance with AASHTO Designation T99 or another method approved by the COR.

1-3.3.3.2.2 Field density.- The field density shall be determined in accordance with AASHTO Designation T191, T205, T238, or another method approved by the COR.

1-3.3.3.2.3 Soil classification.- The classification of satisfactory soil materials shall be determined in accordance with AASHTO Designation M145 or another method approved by the COR.

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1-4 SUBMITTALS

1-4.1 General.-

1-4.1.1 Submittal requirements.- This paragraph is written as an adjunct to Clause 52.235-2(g), Federal Acquisition regulation (48 CFR Chapter 1). The requirements contained in this paragraph take precedence over Clause 52.236-2(g) requirements.

1-4.1.2 Prior to Notice to Proceed.- Specific shop drawings and/or submittal data currently listed and required by the various sections of this specification shall be submitted to the COR for approval. The following submittal items must be approved by the FAA prior to the Notice to Proceed:

Construction schedule
Concrete mix design
Reinforcing steel
Unitary air-conditioner
Electrical equipment
Precast concrete shelter

1-4.1.3 Procedure.- Five complete sets of all shop drawings or product data or both shall be submitted and two sets will be marked and returned to the contractor. Each shop drawing, submitted for approval, shall have in the lower right hand corner, just above the title block, a 4 inch by 4 inch open space in which the COR can indicate action taken. All submittals shall be accompanied by transmittal letters identifying the contents of the submittal. Transmittal letters shall consist of one original and one copy. Submittals shall be made in adequate time for FAA review (30 calendar days maximum) with possible contractor resubmittal (15 calendar days maximum) and FAA resubmittal review (15 calendar days maximum) before the work, which the respective submittal represents, is fabricated or delivered to the site. Work requiring approval shall not be initiated prior to approval of submittal. Submittals shall be checked by the contractor and coordinated with the work of other trades involved before they are submitted for approval. Submittals shall be complete, detailed, and assembled in sets. Lack of completeness or inadequate description will be justification for disapproval. Shop drawings shall bear the following information:

Number of contract drawings and latest revision;
Specification page and paragraph number;
Name of project or facility;
Name of contractor and subcontractor or supplier;
Clearly identified contents and location of work.

1-4.1.4.- By submitting shop drawings, the contractor thereby represents that he has determined and verified the following:

Space limitations;
Coordination with equipment furnished under other specification sections;
Catalog numbers and similar data;
Compliance with requirements of the work and of the contract documents.

1-4.1.5 Shop drawing approval.- The checking, marking or approval of the shop drawings and/or product data by the COR shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is satisfactory. Approval will not relieve the contractor of the responsibility for any error which may exist. The contractor shall be responsible for the dimensions and design of adequate connections, details, and satisfactory construction of all work.

1-4.1.5.1 Approved as submitted.- If "approved as submitted" is marked by the COR, each copy of the shop drawings or product data will be identified as having received such approval by being stamped and dated. After submittal has been approved, no substitution will be permitted without written approval by the COR.

1-4.1.5.2 Approved as noted.- If "approved as noted" is marked by the COR, the shop drawings or product data is satisfactory contingent upon contractor acceptance of corrections, notations, or both and, if accepted, does not require resubmittal.

1-4.1.5.3 Not approved.- If "not approved" is marked by the COR, the shop drawing or submittal data does not meet job requirements and the contractor must resubmit. If shop drawings or submittal data are disapproved, the contractor shall resubmit the corrected material, in the same quantity as specified for the original submittal.

1-4.1.6 Samples.- The Government reserves the right to request samples of any products or materials proposed for use on this project. Specific samples currently listed under various sections of this specification will be required.

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1-5 TEMPORARY FACILITIES

1-5.1 General.- Contractor shall provide and pay for all temporary services and facilities as specified below and as necessary for the proper and expeditious execution of the work. Contractor shall make, or have made, all connections to existing services and sources of supply as necessary and/or indicated and pay all charges for same. Contractor shall provide all labor, materials, equipment and appurtenances necessary for the complete installation, operation and maintenance of all temporary service systems and facilities. All work under this Section shall comply with applicable laws, rules, regulations, codes, ordinances and orders of all federal, state and Local authorities having jurisdiction for the safety of persons, materials and property. Contractor shall remove all such temporary installations and connections when no longer necessary for the project work.

1-5.2 Temporary electric lighting and power.- Contractor shall provide and maintain a temporary lighting and power system for construction and inspection purposes. Contractor shall make all necessary arrangements for temporary electrical services with the local power company to provide and pay for all temporary work or, at contractor's option, contractor shall provide an approved temporary engine generator at the project site.

1-5.3 Temporary water.- Contractor shall make arrangements to furnish a potable water supply for project work, and pay for all temporary water and services.

1-5.4 Temporary toilets and sanitation.- Contractor shall provide ample and suitable onsite sanitary conveniences with proper enclosures for the use of the workers employed on the work. Such conveniences shall be kept clean, be properly ventilated and shall be installed and maintained in conformity with requirements of all laws and ordinances governing such installations. Locations shall be subject to COR approval. After completion of the work such conveniences shall be removed from the site.

1-5.4.1 Toilets.- Toilets shall be portable chemical type with screened enclosures, each having a urinal and closet and mounted on skids. Not less than one unit shall be provided for every 25 full-time employees.

1-5.4.2 Toilet servicing.- Contractor shall be responsible for paying and arranging for each toilet unit to be serviced at least twice a week, including removal of waste matter, sterilizing, recharging tank, refilling tissue holders, and thorough cleaning and scrubbing of entire interior.

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1-6 MATERIALS AND EQUIPMENT

1-6.1 General.- Material and equipment incorporated into the work shall conform to applicable specifications and standards and comply with size, make, type and quality specified, or as specifically approved in writing by the COR. Manufactured and fabricated products shall be designed, fabricated and assembled in accordance with the best engineering and shop practices. Like parts of duplicate units shall be manufactured to standard sizes and gages and shall be interchangeable. Two or more items of the same kind shall be identical and manufactured by the same manufacturer. Products shall be suitable for service conditions. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing. Do not use material or equipment for any purpose other than for which it is designed or specified. Furnish and install products specified, under options and conditions for substitution stated in this section.

1-6.1.1 Manufacturer's instructions.- When contract documents require that installation of work shall comply with manufacturer's printed instructions, copies of such instructions shall be distributed to parties involved in the installation, including two copies to the COR. Maintain one set of complete instructions at the job site during installation and until completion. Products shall be handled, installed, connected, cleaned and conditioned in strict accordance with such instructions and in conformity with specified requirements. If job conditions or specified requirements conflict with manufacturer's instructions, the contractor shall consult with the COR for further instructions. All work shall be performed in accordance with manufacturer's instructions. No preparatory step or installation procedure shall be omitted unless specifically modified or exempted by contract documents.

1-6.1.2 Transportation and handling.- Products shall be delivered in undamaged condition, in manufacturer's original containers or packing, with identifying labels intact and legible. Shipments shall be inspected to ensure compliance with requirements of contract documents and approved submittals, and that products are properly protected and undamaged immediately on delivery. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packing.

1-6.1.3 Storage.- Products shall be stored in accordance with manufacturer's instructions, with seals and labels intact and legible. Products subject to damage by the elements shall be stored in weather-tight enclosures. Temperature and humidity shall be maintained within the ranges required by the manufacturer's instructions. Fabricated products shall be stored above the ground, on blocking or skids to prevent soiling or staining. Products which are subject to

deterioration shall be covered with impervious sheet coverings and adequate ventilation shall be provided to avoid condensation. Loose granular materials shall be stored in a well-drained area on solid surfaces to prevent mixing with foreign matter.

1-6.1.4 Substitutions.- A separate request for each substitution shall be submitted. Each request shall be supported with complete data substantiating compliance of proposed substitution with the requirements stated in the contract documents. Each request shall include product identification, manufacturer's literature including address, product description, reference standards and performance and test data. Samples shall be submitted as applicable. An itemized comparison of the proposed substitution with the product specified shall be included. The following information shall also be included: data relating to changes in the construction schedule; list of changes required in other work or products; and accurate cost data. Substitute products shall not be ordered or installed without written acceptance. In making a formal request for substitution, the contractor represents that investigation of proposed products has proved that the products are equal to or superior in all respects to those specified; that the same warranties or bonds for substitutions as for product specified will be provided; that installation of accepted substitution into work will be complete in all respects; that claims for additional costs caused by substitution will be waived; and that cost data is complete and includes related costs under the contract.

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1-7 CONTRACT CLOSEOUT

1-7.1 General.- The contractor shall require each subcontractor engaged upon the work to bear full responsibility for cleaning up during and immediately upon completion of his work. All rubbish, waste, tools, equipment and other apparatus caused by or used in the execution of his work shall be removed. This shall in no way be construed to relieve the contractor of his primary responsibility for maintaining the building and the site clean and free of debris, and leaving all work in a clean and proper condition acceptable to the COR. All exposed floor surfaces shall be protected against all mechanical damage, mortar or plaster droppings, oil, grease, or other damage that will stain or soil the cement finish. Protection shall be maintained until all work has been completed.

1-7.1.1 Rubbish removal.- Immediately after unpacking, all packing material, case lumber, wrappings, or other rubbish, flammable or otherwise, shall be collected and removed from the building and the premises.

1-7.1.2 Overall cleaning.- Immediately before the final inspection, the entire exterior and interior of the building and the surrounding areas shall be thoroughly cleaned by the contractor, including but not limited to the following:

All construction facilities, debris and rubbish shall be removed from the building and the site.

All finished surfaces within the building shall be swept, dusted, vacuumed, washed or polished as required.

All tools, scaffolding, temporary utility connections or buildings, belonging to the contractor or used under his direction shall be removed from the site.

1-7.2 Project record documents.-

1-7.2.1 Maintenance of documents.- The following documents shall be maintained at the project site:

Contract drawings
Contract specifications
Addenda
Reviewed shop drawings
Change orders
Field test reports
Project correspondence
Other modifications to contract

1-7.2.2 Storage and use of documents. Store record documents apart from documents used for construction. Do not use record documents for construction purposes. Keep documents in clean, dry, legible condition. Provide file cabinets and racks for storage of drawings.

1-7.2.3 Marking devices. - Use red colored pencil for all marking.

1-7.2.4 Recording and labeling.- Label each document "Project Record" in 1-inch high printed block letters. Keep record documents current. Do not conceal or cover up any item of work until the information has been recorded.

1-7.2.5 Submittals.- At completion of project, deliver record documents to COR. Accompany submittal with transmittal letter, containing the following:

Date

Project title and number

Contractor's name and address

Title and number of each record document

Certification that each document as submitted is complete and accurate

Signature of contractor, or his authorized representative

1-7.2.6 Contract documents.-

1-7.2.6.1 Contract drawings.- Legibly mark to record actual construction:

Depths of various elements of foundation in relation to grade floor level

Horizontal and vertical location of underground and overhead utilities and appurtenances referenced to permanent surface improvements

Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure

Field changes of dimension and detail

Changes made by change order or field order

Details not on originally specified drawings

1-7.2.6.2 Contractor specifications and addenda.- Legibly mark each section to record:

Manufacturer, trade name, catalog number, and supplier of each item of equipment actually installed

Changes made by change order or field order

Other matters not originally specified

1-7.2.6.3 Shop drawings.- Shop drawings shall be maintained as record documents; legibly annotate drawings to record changes made after review.

1-7.3 Completion certificate.- When the work is completed, submit written certification that:

Contract documents have been reviewed;
Work has been inspected for compliance with contract;
Equipment and systems have been tested in the presence of the COR and are operational;
Required Operation and Maintenance manuals, data, and parts list have been submitted and approved;
Spare parts have been provided as required;
Required instruction of maintenance personnel had been accomplished; and
Work is completed and premises cleaned and ready for inspection.

1-7.4 Final inspection.- The COR will schedule the final inspection upon approval and endorsement of the contractor's Completion Certification.

1-7.5 Punch list.- The COR will furnish the contractor with a list of discrepancies in the work, material and equipment noted during the final inspection.

1-7.6 Acceptance of work.- The contractor shall correct discrepancies noted during the final inspection, clean the premises and notify the COR that the work is ready for acceptance.

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2-1 CLEARING OF SITE

2-1.1 Scope.- Clear, strip and grub the site.

2-1.2 Applicable documents.- Not used.

2-1.3 Materials.- Not used

2-1.4 Execution.-

2-1.4.1 Limit of operations.- Confine operations to the required limits and take all precautions to protect the remainder of the property from damage.

2-1.4.2 Clearing and grubbing.-

2-1.4.2.1 Limits of work.- Limits of clearing and grubbing shall be confined to the area within the perimeter fencing or the lease lines, and the area necessary to construct the access road. Clearing and grubbing shall consist of clearing the surface of the designated areas of all trees, stumps, brush, undergrowth, hedges, heavy growth of grass or weeds, fences, structures, debris, and rubbish of any nature, natural obstructions or such material which in the opinion of the COR is unsuitable for the foundation or pavements, or other required structures, including the grubbing of stumps, roots, and matted roots, and the disposal from the project of all spoil materials resulting from clearing and grubbing.

Tap roots and other projections over 1-1/2 inches in diameter shall be grubbed out to a depth of at least 18 inches below the finished subgrade or slope elevation. Any trees or plant materials shown on the plans to be moved, shall be relocated as directed by the COR.

Any buildings and miscellaneous structures that are shown on the plans to be removed shall be demolished or removed, and all materials therefrom shall be removed from the site. The remaining or existing foundations, and all like structures shall be destroyed by breaking out or breaking down the materials of which the foundations are built to a depth at least two feet below the existing surrounding ground. Broken concrete, masonry units, or other objectionable material which cannot be used in backfill shall be removed and disposed of. The holes or openings shall be backfilled with acceptable material and compacted.

Holes remaining after the grubbing operation shall have the sides broken down to flatten out the slopes, and filled with acceptable material, moistened and properly compacted in layers to the density required in Section 2-3, EXCAVATING AND BACKFILLING.

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2-2 SITE GRADING

2-2.1 Scope.- Uniformly grade areas within limits specified including adjacent transition areas.

2-2.2 Applicable documents.- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

2-2.2.1 American Association of State Highway and Transportation Officials (AASHTO).-

T99 Moisture Density Relations of Soils Using a 5.5-Pound Rammer and 12-Inch Drop

2-2.3 Materials.- Not used.

2-2.4 Execution.-

2-2.4.1 Grading outside building lines.- Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes.

2-2.4.1.1 Low or unsurfaced areas.- Finish areas to within no more than 0.10 feet above or below required elevation.

2-2.4.1.2 Surfaced area.- Shape subgrade under surfaced areas to line, grade and cross-section, with finish surface not more than 1/2 inch above or below required subgrade elevation.

2-2.4.2 Compaction.- After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

2-2.4.2.1 Testing for compaction.- The required compaction tests shall be performed by the approved testing laboratory. The maximum density for each class of material shall be in accordance with AASHTO T99. The field density shall also be determined by AASHTO T99.

2-2.4.2.2 Surfaced areas and building slab subgrade.- Make at least one field density test of subgrade for every 2000 square feet of surfaced area or building slab, but in no case less than three tests. In each compacted fill layer, make one field density test for every 2000 square feet of overlaying building slab or surfaced area, but in no case less than three tests.

2-2.4.3 Disposal of excess materials.- Remove from the site excess earth and excavated materials unsuitable for fill, including trees, stumps, and rubbish. Removal and disposal shall be in conformance with Government, airport and local regulations.

2-2.4.4 Maintenance.-

2-2.4.4.1 Protection of graded areas.- Protect graded areas from traffic and erosion. Keep free of trash and debris. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerance.

2-2.4.4.2 Reconditioning compacted areas.- Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

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2-3 EXCAVATING AND BACKFILLING

2-3.1 Scope.- Excavate, fill and backfill for structures, access road, fenced area and electrical facilities.

2-3.2 Applicable documents.- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

2-3.2.1 American Association of State Highway and Transportation Officials (AASHTO).-

M145	Classifiation of Soils and Soil Aggregate Mixtures for Highway Construction Purposes
T99	Moisture Density Relations of Soils Using a 5.5-Pound Rammer and 12-Inch Drop

2-3.3 Materials.-

2-3.3.1 Crushed stone - type and size.- Crushed stone shall consist of crushed gravel or crushed rock which is hard, strong, durable, free from adherent coatings, and shall contain no soft, thin or elongated pieces, dirt, or organic material. Material shall be secured from an acceptable source off-site. Particle size shall be 1-1/2 inch maximum and a maximum 2 percent by weight passing size 4 sieve.

2-3.3.2 Earth fill.- Fill shall be well graded inorganic fill, with 100 percent passing a 3 inch sieve, and 5 percent to 15 percent passing a No. 200 sieve, and having a plasticity index of 5.0 or less. Fill required under access road shall conform to AASHTO M-145, Group A-2.

2-3.3.3 Borrow.- Excavated material from the site that is suitable as approved by the COR, may be used for filling or backfilling. Procure any additional material as necessary for site fill from approved borrow pits.

2-3.3.4 Filtration/separation fabric.- A non-woven fabric, needle punched and heat fused of 100 percent polypropylene staple fiber; permeable to moisture transmittal, minimum 4.5 ounces per square yard; and conforming to the following additional criteria:

Grab strength, length direction. lb. = 90
Grab strength, width direction, lb. = 110
Elongation at break, length direction, percentage 65
Elongation at break, width direction, percentage 65
Coefficient of permeability K, c/Sec 5 x 10^{-2}

2-3.4 Installation.-

2.3.4.1 Excavating extent.- Excavation is unclassified and includes the removal of all materials including earth and rock of any type and obstructions of any type, either natural or man made. Excavate to the depths and dimensions indicated for footings, piers, slabs on grade, and other structures. In the event unsuitable or unstable soil is encountered below this limit, the COR will determine the depth of removal of such soil. Cut sides and bottom of footing excavations clean. Allow sufficient room for installation and inspection of forms.

2.3.4.1.1 Unauthorized excavation and low areas.- Where the excavation is carried beyond the lines indicated, fill to the subgrades as follows:

2-3.4.1.1.1 Footings and piers.- Where soil bearing footings and piers for the new structures will occur, the fill shall be concrete of the same proportions as specified for footings and piers.

2-3.4.1.1.2 Slab on grade.- Earth fill as specified.

2-3.4.2 Protection of excavation.-

2-3.4.2.1 Grading.- Control the grade around excavations so that ground is pitched or dammed to prevent surface water from running into excavation.

2-3.4.2.2 Banks.- Protect exposed banks of excavation from washing and caving. If necessary, cover them with polyethylene sheet or use other approved means.

2-3.4.3 Filling and backfilling.-

2-3.4.3.1 General.- Unless otherwise specified, place all fills and backfills in layers compatible with compaction requirements, but not in layers exceeding eight inches for the entire width so that each layer can be uniformly and properly compacted.

2-3.4.3.2 Filling and backfilling under slabs.- Remove forms, lumber, trash, and other objectionable material and install fill and backfill in equal layers compatible with the equipment being used. Compact each layer as specified. Backfill as the work progresses. Selected materials from excavations, meeting specified requirements, and having the plasticity index specified will be acceptable. Compaction shall be equal to that of the undisturbed soil. Grade final layer to required elevation and dress smooth.

2-3.4.3.3 Filling and backfilling under access road and fenced area.- Remove forms, lumber, trash and other objectionable material and place fill and backfill in layers not over six inches loose measure. Compact each layer as specified.

2-3.4.3.4 Backfilling exterior conduit trenches.- After conduit has been checked, or tested if required, and approved, backfill trenches with fine, loose earth, free from large clods or stones, carefully deposit on both sides of the conduit and thoroughly tamp until enough fill has been placed to provide a cover at least one foot above the conduit. Place the remainder of the backfill in layers and compact as specified. After backfilling, dress off trenches to conform to adjacent contours. If trenches are improperly filled or if settlement occurs, they shall be refilled and redressed at not cost to the FAA. Maintain backfill areas and refill and redress areas that have settled.

2-3.4.4 Installing filtration/separation fabric.- Surface to receive fabric shall be prepared as specified. Material shall be placed according to the manufacturer's instructions. At time of installation the fabric will be rejected if it has rips, flaws, deterioration, damage or defects incurred during manufacture, transport, storage or handling.

2-3.4.5 Installing crushed stone.- The crushed stone shall be spread evenly over the prepared subgrade, backfill, or filtration/separation media so that after rolling, the thickness of the course shall be as indicated. Maintain the grading of the material during spreading and rolling so that no segregation of sizes occurs and no pockets of fine material are formed.

2-3.4.6 Compaction requirements.-

2-3.4.6.1 Fill and backfill under slabs and structures.- Maximum density shall be 95 percent at optimum moisture in accordance with AASHTO T99.

2-3.4.6.2 Subgrade under access road and fenced area.- Maximum density shall be 95 percent at optimum moisture in accordance with AASHTO T99, for a minimum depth of 12 inches.

2-3.4.6.3 Other areas.- Compact fill areas not described to 90 percent maximum density at optimum moisture in accordance with T99.

2-3.4.6.4 Equipment.- Approved compaction equipment making a minimum of four complete passes over the entire area.

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3-1 CONCRETE FORMWORK

3-1.1 Scope.- Furnish and install forms and related work required for cast-in-place concrete.

3-1.2 Applicable documents.- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification.

3-1.2.1 American Concrete Institute (ACI) Publications.-

318 Building Code Requirements of Reinforced Concrete

3-1.2.2 American Society for Testing and Materials (ASTM).-

A307 Low Carbon Steel Externally Threaded Standard Fasteners

3-1.2.3 U.S. Department of Commerce, Product Standard.-

PS1-66 Softwood Plywood - Construction and Industrial

3-1.3 Materials.-

3-1.3.1 Plywood.- Plywood shall comply with PS1-66 and bear grade trademark of the American Plywood Association. B-B Plyform, Class 1, exterior, 5/8 inch thick minimum.

3-1.3.2 Accessories.- Required type, size and finish.

3-1.3.3 Form coating.- Non-staining chemical compound.

3.1.3.4 Anchor bolts and plates.- See Section 13-1.

3-1.3.5 Tubular fiberforms.- Spirally constructed of laminated plies of fiber. Wall thickness as recommended by the manufacturer to meet load requirements. Outside surface wax coated for moisture resistance. Inside surface coated with bond-breaker compound and fabricated so that finish concrete surfaces are smooth and free of spiral and seam marking.

3-1.4 Installation.-

3-1.4.1 General.- Location of inserts, and anchors, will be furnished by building fabricator. Build such items into forms in a manner that will prevent displacement or damage to them during placing of concrete. Verify sizes and locations. Inspect all construction documents to ensure the proper installation of embedded items and provision of openings.

3-1.4.2 Forms for concrete.-

3-1.4.2.1 General.- Locate and construct forms accurately so that finished concrete will conform to shapes, lines, grades and dimensions indicated. Joints shall be vertical unless otherwise specified, and tight to prevent leakage.

Size forms so that reinforcing rods, ties, and other accessories have the minimum coverage required by the structural general notes. Thickness of concrete coverage shall be measured from face of vertical or horizontal bars and face of stirrups in beams. Coverage not indicated shall conform to ACI 318.

3-1.4.2.2 Plywood forms.- Contact surface shall be free of warpage, cupping and large or loose knots.

3-1.4.2.3 Ties and spreaders.- Lengths shall be as required to provide proper concrete thickness. When practical, locate and space ties and spreaders symmetrically both ways, in plumb tiers and level rows.

3-1.4.3 Form coating.- Coat the inside of forms in accordance with coating manufacturer's printed installation instructions.

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3-2 CONCRETE REINFORCEMENT

3-2.1 Scope.- Fabricate and install reinforcing and the related accessories required for cast-in-place.

3-2.1.2 Related work in other sections.-

Cast-in accessories and inserts: Examine other sections for extent.

3-2.2 Applicable documents.- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

3-2.2.1 American Society for Testing and Materials (ASTM) Publications.-

A185 Welded Steel Wire Fabric for Concrete Reinforcing
A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

3-2.2.2 American Concrete Institute (ACI).-

318 Building Code Requirements for Reinforced Concrete

3-2.2.3 Concrete Reinforcing Steel Institute (CRSI).-

Manual of Standard Practice and Recommended Practice for Placing Reinforcing Bars

3-2.3 Materials.-

3-2.3.1 Reinforcing steel bars.- ASTM A615, Grade 40, modified in accordance with ACI 318. Carrying rolled-on identifying marks to denote the mill location, bar size and type of steel.

3-2.3.2 Welded steel wire fabric.- ASTM A185.

3-2.3.3 Metal accessories.- As recommended by CRSI Manual of Standard Practice.

3-2.4 Installation.-

3-2.4.1 Marking.- Use standard waterproof tags. All designations shall coordinate with the Structural Drawings.

3-2.4.2 Tolerance.- The following are maximum allowable tolerances:

3-2.4.2.1 Fabrication.-

Sheared length:	Plus or minus 1 inch.
Depth of truss bars:	Plus 0 or minus 1/2 inch.
Stirrups, ties:	Plus or minus 1/2 inch.
All other bends:	Plus or minus 1 inch.

3-2.4.2.2 Placement.-

Concrete cover to form surfaces:	Plus or minus 1/4 inch.
Minimum spacing between bars:	1/4 inch.
Top bars in slabs:	
Members 8 inches or less deep:	Plus or minus 1/4 inch.
Crosswise of members:	Space evenly within 2 inches of stated separation.
Lengthwise of members:	Plus or minus 2 inches.
Maximum bar movement to avoid interference with other reinforcing steel, conduit or other embedded work:	1 bar diameter.

3-2.4.3 Fabrication of reinforcing bars.-

3-2.4.3.1 Forming.- Unless noted otherwise, bend bars cold. Do not straighten or rebend without specific approval from COR. Torch cutting at the job will not be permitted without prior approval of the COR.

3-2.4.3.2 Laps and splices.- Use a minimum number of splices. Lap splices in strict accord with ACI 318 or as indicated. Do not make splices at points of maximum stress. Stagger splices in adjacent bars.

3-2.4.4 Cleaning.- Remove reinforcing scale, heavy rust, and any coating which would reduce bond.

3-2.4.5 Placement.-

3-5.4.5.1 Slabs.-

3-2.4.5.1.1 Grade supported slabs.- Support reinforcing on sheet metal chairs spaced 4 feet apart.

3-2.4.5.1.2 Welded wire fabric.- Roll out flat in longest practical lengths. Lap joints one mesh plus 2-inches, 6-inches minimum. Offset end laps of adjacent widths to prevent continuous lap. Fasten ends and sides of mesh at 48 inches on-center with tie wire.

3-2.4.5.2 Anchor bolts.- If reinforcing conflicts with location of anchor bolts, or inserts required to be encased in concrete, submit prompt notifications so that revisions can be made before concrete is placed. No cutting of reinforcing will be permitted without prior approval from the COR.

3-3 CAST-IN-PLACE CONCRETE

3-3.1 Scope.- Provide portland cement cast-in-place concrete.

3-3.2 Applicable documents.- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

3-3.2.1 American Society for Testing and Materials (ASTM) Publications.-

C33	Concrete Aggregates
C94	Ready-Mixed Concrete
C150	Portland Cement
C260	Air-Entraining Admixtures for Concrete
C494	Chemical Admixtures for Concrete
C618	Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

3-3.2.2 American Concrete Institute (ACI).-

301	Structural Concrete for Buildings

3-3.2.3 U.S. Department of Commerce Commercial Standards (CS).-

CS-238	Polyethylene Sheet

3-3.3 Materials.-

3-3.3.1 Cement.- ASTM C150, Type I Grey Portland Cement. The use of Type III permitted only with specific approval.

3-3.3.2 Stone aggregate.- Conforming to ASTM C33. Fine-Natural sand. Coarse-Gravel or crushed stone, 1-1/2 inch maximum.

3-3.3.3 Water.- Potable.

3-3.3.4 Chemical admix.- ASTM C494 Type A or D (Type E may be used in cold weather upon written approval) polymer type compound (lignon compounds not acceptable) in liquid form.

3-3.3.5 Air entraining admix.- ASTM C260 liquid vinsol resin compound compatible with chemical admix used.

3-3.3.6 Vapor barrier.- Six-mil, clear polyethylene sheeting, CS-238.

3-3.3.7 Fly ash.- ASTM C618, Class C or Class F, loss on ignition shall not exceed 1 percent.

3-3.4 Installation.-

3-3.4.1 General.- Check with other trades prior to placing concrete to ascertain that their work is in place.

3-3.4.2 Cast-in anchors and accessories.- Carefully place items required to be cast into concrete.

3-3.4.3 Testing.- Provide material and cooperate with testing laboratory.

3-3.4.4 Retempering.- Concrete that is partially hardened shall not be retempered.

3-3.4.5 Strength tests.- Conform to the requirements of ASTM C94.

3-3.4.6 Minimum compressive strength.- 3000 psi at 28 days, unless indicated otherwise.

3-3.4.7 Structural concrete - proportioning.-

3-3.4.7.1 General.- Conform to ACI 301 Standards. The mix design is intended to produce concrete which, when cured, will have a 28-day compressive strength equal to or greater than that required. If the strength required is not attained with the minimum cement content, additional cement shall be used or other aggregate provided.

3-3.4.7.2 Proportioning of ingredients.- Determine mix proportions in conformance with ACI Standards using Method 1 or 2.

3-3.4.7.3 Chemical admix.- Quantity, preparation and mixing shall conform to admix manufacturer's directions for use at temperatures anticipated when concrete will be placed.

3-3.4.7.3.1 Option.- Admix may be used at the contractor's option. If used, adjust formulas for concrete mix to provide for it and obtain COR approval before concrete is ordered.

3-3.4.7.4 Air-entraining admix.- Conform to admixture manufacturer's directions for quantity, preparation and mixing.

3-3.4.7.5 Mixing.- Concrete shall be procured from an approved "ready-mixed" concrete plant as follows:

Transit or ready-mixed concrete and delivery operations - Conform to ASTM C94. Do not add water at the job unless prior approval is given. Record the amount of any added water on each copy of the Delivery Ticket. If water is added, mix batch an additional 1 minute per yard of concrete, at slow speed, before placing it. Use no concrete which has been held in a mixer truck longer than 1-1/2 hours.

3-3.4.8 Structural concrete - placement.-

3-3.4.8.1 General.- Conform to ACI 301 Standards. Verify that forms are clean and coated, and that reinforcing, conduit, sleeves, anchors, and other inserts required to be cast in concrete have been properly installed. Such work shall be inspected and approved before placing is begun.

3-3.4.8.2 Temperatures.- Do not place concrete unless temperature is at least 40°F and rising. For temperatures below 40°F, special approved methods will be required.

3-3.4.8.3 Method.- Place concrete in the forms as rapidly as practical by methods that will prevent loss or separation of the ingredients.

3-3.4.8.4 Compaction.- Thoroughly compact concrete during and immediately after placement by means of mechanical vibrators.

3-3.4.8.5 Forms.- If forms become displaced in any way during placing of concrete, immediately stop the operation and do not resume placing until forms have been rebraced and brought back to required lines and levels.

3-3.4.9 Structural concrete - special requirements.-

3-3.4.9.1 Excavated areas.- Excavation shall be inspected and approved before concrete is placed. Do not place concrete on wet or soggy ground without first laying and compacting a bed of broken stone or gravel of sufficient thickness to keep the mud from mixing with the concrete. Where water is present keep the level below the newly placed concrete during placing and for at least 24 hours thereafter.

3-3.4.9.2 Slabs.- Cover conduit with a minimum of 1 inch of concrete.

3-3.5 Quality assurance.-

3-3.5.1 Submittals.- Conform to procedures specified.

3-3.5.1.1 Concrete source.- Before ordering, submit and obtain approval of source of concrete, and source of dry-batch material.

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3-4 FINISHING AND CURING

3-4.1 General.-

3-4.1.1 Scope.- Finish and cure the cast-in-place concrete.

3-4.2 Applicable documents.- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

3-4.2.1 Federal Specifications (FS).-

UU-B-790 Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)

3-4.2.2 American Society for Testing and Materials (ASTM) Publications.-

C171 Sheet Materials for Curing Concrete

3-4.2.3 American Concrete Institute (ACI).-

301 Structural Concrete for Buildings
302 Recommended Practice for Concrete Floor and Slab Construction

3-4.2.4 U.S. Department of Commerce Commercial Standards (CS).-

CS-238 Polyethylene Sheet

3-4.3 Materials.-

3-4.3.1 Waterproof paper.- ASTM C171, Type I or FS UU-B-790 reinforced Kraft paper.

3-4.3.2 Plastic sheet.- U.S. Commerical Standard CS-238 polyethylene sheet in 4 mil minimum thickness.

3-4.4 Installation.-

3-4.4.1 Tolerance - horizontal surfaces.-

3-4.4.1.1 Standards.- Conform to ACI 301.

3-4.4.1.2 General.- Edges of areas shall be level and true to line against forms. Screed surface using specially fabricated straightedges (not lengths of lumber) and wet screeds.

3-4.4.2 Finishes.-

3-4.4.2.1 Standards.- Conform to ACI 301.

3-4.4.2.2 Apron.- Steel trowel and medium broom finish with edges finished with edging tool. Broom after concrete is hard enough to retain a scoring.

3-4.4.3 Curing.-

3-4.4.3.1 General.- Protect concrete from loss of moisture, rapid drying or temperature changes, injurious action by the sun, rain, flowing water, or frost, and mechanical injury, at a temperature not less than 50°F, from the time of placing until the end of the time of curing. Keep wood forms, left in place during curing, damp at all times to prevent opening at the joints and drying of concrete. No period during which moisture or warmth is lacking shall be counted effective for curing.

3-4.4.3.2 Methods.-

3-4.4.3.2.1 Duration.- Cure concrete for at least 7 days. During curing time do not work on or allow traffic on aprons being cured.

3-4.4.3.2.2 Moist curing.- Use one of the following methods:

Cover surface with cotton mats.
Keep surface covering constantly wet.
Cover surface with wetted burlap mats, placing burlap side down.
Lap joints between mats 3 inches or more.

3-4.4.3.2.3 Impervious sheet curing.- Wet surface with fine spray then cover it with plastic sheet or waterproof paper. Lap joints at least 4 inches and seal with tape. Weight sheeting to prevent displacement. Repair tears and other damage.

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13-1 PRECAST CONCRETE SHELTER

13-1.1 General.-

13-1.1.1 Scope.- Design, fabricate, assemble, transport and install at the site precast concrete equipment shelter complete including: interior finish materials, exterior door, frame, hardware, drip cap, unitary air conditioner, electrical equipment and fixtures.

13-1.1.2 Related work in other sections.-

Site preparation, footings, foundations and apron: DIVISIONS 2 and 3
Unitary air-conditioner: Section 15-1
Electrical: Section 16-1.

13-1.2 Applicable documents.- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification.

13-1.2.1 Federal Specifications (FS).-

FF-H-106	Hardware, Builders' Locks and Door Trim
FF-H-111	Hardware, Builders'; Shelf and Miscellaneous
FF-H-116	Hinges, Hardware, Builders'
HH-I-530	Insulation Board, Thermal (Urethane)
HH-I-524	Insulation Board, Thermal (Polystyrene)
QQ-S-775	Steel Sheets, Carbon, Zinc Coated
SS-W-40	Wall Base; Rubber and Vinyl Plastic
TT-S-227	Sealing Compound; Elastomeric Type, Two Component

13-1.2.2 Federal Standards.-

141	Paint, Varnish, Lacquer, and Related Materials; methods for Sampling and Testing

13-1.2.3. American Concrete Institute (ACI).-

224.1R	Causes, Evaluation, and Repair of Cracks in Concrete Structures
304.5R	Batching, Mixing, and Job Control of Lightweight Concrete
305R	Hot Weather Concreting
306R	Cold Weather Concreting
309	Standard Practice for Consolidation of Concrete
318	Building Code Requirements for Reinforced Concrete

13-1.2.4 American National Standards Institute (ANSI).-

A115	Specifications for Door and Frame Preparation for Hardware
A115.1	Mortise Door Locks

A115.2 Bored or Cylindrical Locks for 1-3/4-Inch Doors
A156 Butt Hinges

13-1.2.5 American Society for Testing and Materials (ASTM) Publications.-

A36 Structural Steel
A185 Welded Steel Wire Fabric for Concrete Reinforcement
A525 General Requirements for Zinc Coated (Galvanized) Sheet Steel by the Hot Dip Process
A615 Deformed and Plain Billet - Steel Bars for Concrete Reinforcement
B117 Salt Spray (Fog) Testing
C31 Method of Making and Curing Concrete Test Specimens in the Field
C33 Concrete Aggregates
C39 Test Method for Compressive Strength of Cylindrical Concrete Specimens
C150 Portland Cement
C172 Method of Sampling Freshly Mixed Concrete
C260 Air-Entraining Admixtures for Concrete
C330 Lightweight Aggregates for Structural Concrete
C494 Chemical Admixtures for Concrete
D816 Method of Testing Rubber Cements
D822 Recommended Practice for Operating Light and Water - Exposure Apparatus (Carbon Arc type) for Testing Paint, Varnish, Lacquer and Related Products
D1000 Method of Testing Pressure - Sensitive Adhesive Coated Tapes Used for Electrical Insulation
D1735 Method for Water Fog Testing of Organic Coatings
D2729 Polyvinyl Chloride Sewer Pipe and Fittings
D3574 Method of Testing Flexible Cellular Materials - Slab, Bonded and Molded Urethane Foams
G53 Recommended Practice for Operating Light - and Water - Exposure Apparatus (Fluorescent UV - Condensation type) for Exposure to Nonmetallic Materials.

13-1.2.6 American Welding Society (AWS).-

D1.1 Structural Welding Code
D1.4 Structural Welding Code - Reinforcing Steel

13-1.2.7 Steel Door Institute (SDI).-

TDS 100 Recommended Specifications Standard for Steel Doors and Frames

13-1.2.8 Underwriters Laboratories, Inc. (UL) Publication.-

UL-752 Bullet Resistant Material, High Powered Rifle Threat 216-2562 FPS94V-0

13-1.3 Materials.-

13-1.3.1 General.- Design shelter to meet the following minimum structural requirements: wind load of 100 miles per hour; roof live load of 40 pounds per square foot; floor live load of 180 pounds per square foot; seismic zone III; bullet resistant precast material which will stop a .30-06 bullet at a 100 foot range in accordance with UL-752.

13-1.3.2 Cement.- Portland cement, ASTM C150 Type 1 or 111.

13-1.3.3 Water.- Potable, containing no impurities harmful to concrete or reinforcing steel.

13-1.3.4 Aggregates.- Fine aggregate: washed natural sand, ASTM C33. Lightweight coarse aggregate, ASTM C330.

13-1.3.5 Chemical admixtures.- Water reducing admixtures, ASTM C494. Air-entraining admixtures, ASTM C260.

13-1.3.6 Reinforcement.- Steel bars: ASTM A615, Grade 60, modified in accordance with ACI 318. Welded steel wire fabric: ASTM A185 and ACI 318. Welding shall conform to AWS D1.1 and D1.4.

13-1.3.7 Formwork.- Fibrous-glass reinforced plastic, steel or epoxy-coated concrete.

13-1.3.8 Steel plates and shapes.- ASTM A36.

13-1.3.9 Metal primer, galvanized.- Rust-O-Lastic zinc dust primer No. 073-218, as manufactured by M. A. Bruder & Sons or approved equal.

13-1.3.10 Wall joint seals.- Precompressed expanding foam sealant tape, Will-Seal Illusbruk/USA Number 3122 or approved equal conforming to the following physical properties:

Density:	8-10 lb/cu ft. tape type 150
Thermal Conductivity:	0.05 K Cal/N°C
Temperature Stability Range:	-40°F to 212°F
Bleeding:	None at 392°F at 20% compression
Resistance to Compression Set:	ASTM D 3574 meets max. 2%
Peel Strength:	ASTM D 1000 meets (at 1.57 rad.) 0.25 revolutions min. 12N/25mm
Softening Point:	ASTM D 816 surpasses 50°C min.
Shear Strength:	Min. $8N/cm^3$
Mildew Resistance:	Excellent
Staining:	None
Flammability:	Self-extinguishing per UL 94V-0
Flash Point:	590°F

Sealing Properties:	Compression at 20% of expanded thickness gives a seal strength of 0.5 atmosphere or withstands a water pressure of 6-3/4 sq. ft. head of water (tape type 150)
Outdoor Exposure:	Excellent resistance to UV light
Accelerated aging:	825 hours - minor surface degradation (procedure ASTM G53)

13-1.3.11 Roof and wall sealer.- Solvent-based acrylic coating, Thoroglaze H, as manufactured by Thoro System Products or approved equal.

13-1.3.12 Polyvinyl chloride (PVC) pipe.- ASTM D2729, Schedule 40.

13-1.3.13 Sealant.- One part acrylic terpolymer, FS TT-S-227, Type II, non-sag. Mono, as manufactured by Tremco, or approved equal, color to match adjacent material.

13-1.3.14 Insulation board.- One of the following materials, in a thickness of 1-1/2 inches per layer, which will produce overall average C factor as indicated on the drawings: Polyisocyanurate, FS HH-I-530, Grade 2, Class 2, Style D, Urethane, FS HH-I-530, Grade 2, Class 2, Style B or D, Polystyrene, FS HH-I-524. Adhesive or mastic shall be the type recommended by the manufacturer of the insulation material selected.

13-1.3.15 Framing lumber.- Standard grade, maximum 19 percent moisture content.

13-1.3.16 Wood paneling.- Fiberglass reinforced polyester surfaced plywood. Panels shall be 4 feet by 10 feet by 1/2 inch, finished in a white, textured embossed design. Adhesive as recommended by the paneling manufacturer.

13-1.3.17 Resilient flooring.- No-wax vinyl composition tile, 12 inches by 12 inches by 1/8 inch. Azrock Floor Products Company or an approved equal. Adhesive a standard product of the tile manufacturer.

13-1.3.18 Cove base.- Vinyl, FS SS-W-40, 4 inches high, Type II, 1/8 inch thick, with molded top.

13-1.3.19 Steel door and frame.- Steel Door Institute, Type III, Extra Heavy Duty, Seamless Style 2 or 3. Prime grade, cold rolled sheet steel, annealed and process leveled, with smooth, clean surface. Steel shall be zinc coated, coating weight at least 0.10 ounces per square foot, conforming to ASTM A525 and FS QQ-S-775, Type I, Class D.

13-1.3.19.1 Primer.- Type standard with door manufacturer and in accordance with SDI.

13-1.3.19.2 Thermal insulation.- Type standard with the door manufacturer. Minimum thermal transmission coefficient (U value) = 0.10.

13-1.3.19.3 Hardware.-

13-1.3.19.3.1 Hinges.- Hinges shall conform to ANSI A156, Type A5133 with fast pin. Size and number of hinges shall conform to the requirements specified in FS FF-H-116.

13-1.3.19.3.2 Lockset.- FS FF-H-106, Type 86J (ANSI 1000-26, Type F05). Ball knob design with escutcheon, US 32D, removable and interchangeable 7 pin core all as manufactured by Best Universal Lock Company, Inc., Indianapolis, Indiana. No substitutes will be accepted.

13-1.3.19.3.3 Threshold.- Extruded aluminum, alloy 6063T5, mill finish.

13-1.3.19.3.4 Door stop and holder.- FF-H-111, Type 1321E with hook and keeper, attachment by steel stud, with expansion shield and auxiliary machine screw.

13-1.3.20 Security bar.- 1-inch diameter stainless steel tubing, .049-inch wall thickness. Return wall bracket 2-1/2-inch diameter with two tamper-proof fasteners on each bracket.

13-1.3.21 Fabrication.-

13-1.3.21.1 Doors and frames.-

13-1.3.21.1.1 Door construction.- Door clearances shall not exceed the following: 1/8 inch at jambs and head and 3/4 inch at bottom measured from finished floorline. Door shall have top and bottom edges closed flush and sealed against water penetration.

13-1.3.21.1.2 Frame construction.- Pressed steel frame shall be of the combination buck, and trim type of the size and detail shown. Gage of metal shall be not lighter than 16 gage. Frame shall be welded unit type.

13-1.3.21.1.3 Welded unit type frame.- Frame shall have header and jambs secured at the corners by external welding of faces and grinding smooth. Faces of frame at junction of head and jamb shall present neat line joints, invisible under paint finish.

13-1.3.21.1.4 Anchors.- Frame shall be provided with a minimum of three through bolt frame anchors each jamb as shown for the adjoining wall construction, and anchors for attachment of frame to the floor. Special frames designed for placement in the formwork and cast integral with the precast panels are an acceptable alternative to through bolt anchored frames.

13-1.3.21.2 Preparation for hardware. - Door and frame shall be prepared for hardware in conformance with the templates provided under requirements of ANSI A115, A115.1, and A115.2. Cutting, reinforcing, drilling and tapping of door and frame shall be done at the factory. Reinforcement of door and frame for hardware shall be in accordance with the following table:

REINFORCEMENT

Hardware Item	Minimum Gage	Minimum Size
Hinges	Door 10	8" x 1-5/8"
	Frame 10	8" x 1-5/8"
Lockset	Door 14	10" x 3-3/4"

13-1.3.21.3 Cleaning and prime painting.- Door and frame shall be thoroughly cleaned, phosphatized and primed with one coat of baked-on rust-inhibiting prime paint, capable of passing a 120-hour salt spray test in accordance with ASTM B117 and a 250-hour humidity test in accordance with ASTM D1735.

13-1.3.21.4 Finish painting.- Door and frame shall be prefinished with two coats of baked-on enamel or acrylic paint capable of passing a 240-hour salt spray and a 500-hour humidity test in accordance with FS 141 and a 500-hour weather exposure test in accordance with ASTM D822. Finish paint shall have a dry film thickness of 1.50 to 2.0 mils. Color as selected by COR.

13-1.4 Installation.-

13-1.4.1 Forms for structural concrete.- Design and construction of formwork is the precaster's responsibility.

13-1.4.1.1 Tolerances.-

PVC penetrations:	+/-1/4 inch;
Blockouts and door frame location:	+/-1/4 inch;
Wall, roof, and floor panels:	+1/8 inch/-3/16 inch;
Joint width for all interfaces:	+1/4 inch/-1/8 inch.

13-1.4.2 Strength requirements.- Minimum compressive strength = 4000 psi at 7 days and 5000 psi at 28 days. Compressive strength shall be at least 2500 psi at time of form removal, in accordance with ASTM C39, or impact hammer test. Concrete shall have a slump of 1 to 3 inches before the addition of plastisizer.

13-1.4.3 Proportioning.- Measure, mix, transport and place concrete in accordance with ACI 304.5R.

13-1.4.3.1 Air-entraining admixture.- Conform to admixture manufacturer's directions for quantity, preparation and mixing.

13-1.4.3.2 Consolidation.- Conform to ACI 309.

13-1.4.3.3 Hot and cold weather concreting.- Conform to ACI 305R and 306R.

13-1.4.4 Curing.- Concrete shall be cured in the forms and protected against moisture loss, freezing, and excessive heat until compressive strength reaches initial set. Cured concrete shall have a density of 100-120 pcf, as determined by weighing test samples prior to strength testing.

13-1.4.5 Strength tests.- A concrete sample for strength tests shall be taken for each concrete batch. Three samples shall be prepared, one for a seven day test, one for a 28 day test, and one spare. Samples shall be taken in accordance with ASTM C172 and molded in accordance with ASTM C31. Test samples in accordance with ASTM C39. Furnish the services of an independent testing laboratory. Submit certified results of all tests performed.

13-1.4.6 Prime painting.- Welded connections shall be thoroughly cleaned and prime painted.

13-1.4.7 Defective and damaged precast concrete.- Cracks and chips which do not affect the structural integrity shall be repaired if required for asthetic purposes. Such repairs shall not be visually distracting and made watertight; conforming to ACI 224.1R. Severe cracks, spalling or impairment of structural adequacy shall be cause for rejection.

13-1.4.8 Attachment of wood furring and paneling.- Wood furring shall be fastened to walls with Ramset nails, use tapcons if within six inches of an opening. Plywood shall be fastened to furring with panel adhesive and finish nails spaced 3 feet on centers. Ceiling joists shall be toe-nailed to wall studs and fastened at center of span with clip angles.

13-1.4.9 Joint seals.-

13-1.4.9.1 Preparatory work.- Surfaces to be sealed shall be made sound, dry, and cleaned of oil, grease, laitance, and other foreign material that would prevent proper adhesion. Patch voids and grooves in the surface of the concrete to receive seals. Grind concrete smooth as necessary to produce a smooth surface.

13-1.4.9.2 Placement.- Place seal material in accordance with the manufacturer's published instructions.

13-1.4.10 Exterior surface sealer.- Prior to application of sealer, thoroughly clean surface by application of water or air. Apply sealer in accordance with the manufacturer's published instructions.

13-1.4.11 Resilient flooring.-

13-1.4.11.1 Preparatory work.- Remove foreign substances from surfaces to receive tile flooring. Fill joints, cracks and other irregularities with approved patching material. Prime surfaces, if recommended, by adhesive manufacturer.

13-1.4.11.2 Application.- Evenly spread approved adhesive on surfaces as recommended by tile manufacturer. While adhesive is tacky, embed each tile firmly in place to ensure proper bond.

13-1.4.12 Reinstalling removed items. - After installing shelter on the foundation reinstall items of equipment which were removed at the factory to facilitate transportation.

13-1.5 Quality assurance.-

13-1.5.1 Manufacturer qualifications.- Regularly engaged in the fabrication of precast concrete shelter with existing plant facilities equipped for year around shelter manufacturing. Capable of and experienced in transporting shelter to a remote site and installing same on preprepared foundations using specialized trucks, trailers and cranes having the plant capability to produce multiple shelters simultaneously.

13-1.5.2 Sample panel.- Submit, to the COR, prior to fabrication of shelter a 12-inch by 12-inch by 1-inch sample panel representing color, texture and general finish of final precast product.

13-1.5.3 Submittals.- Conform to the procedures specified.

13-1.5.3.1 Shop drawings.- Shop drawing shall including the following:

Shelter plan and elevations;
Details of structural connections at floor;
Roof and panel-to-panel;
Sealed joint details;
Door and frame details;
Equipment connection to structure details;
Interior finish details;
Plans and interior wall elevations showing the location and dimensions of unitary air-conditioner and electrical equipment and required wall openings.
Electrical schematics and equipment list;
Manufacturer's literature and catalog cuts for proposed equipment and finish materials.
Calculations proving conformance of the shelter to the design criteria specified. Certification of compliance to UL-752.
Drawings and calculations shall be stamped and certified by a registered professional engineer.

13-1.5.4 Leakage testing.- Factory test completed shelter by concentrating a water spray of not less than 50 psi aimed at the roof and each side. Concentrate the spray against the shelter for 10 minutes every 3 feet of shelter length along the roof and sidewall panels and panel joint interfaces. If leaks are discovered make repairs accordingly and repeat test until shelters are completely watertight.

* * * * *

15-1 UNITARY AIR-CONDITIONER

15-1.1 Scope.- Furnish and install a single package, wall mounted, unitary air-conditioner including metal wall sleeve, interconnecting wiring and direct digital control system.

15-1.2 Applicable documents.- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification.

15-1.2.1 American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).-

Standard 52	Equipment Volume - Method of Testing Air-Cleaning Device used in General Ventilation for Removing Particulate Matter

15-1.2.2 Air-Conditioning and Refrigeration Institute (ARI).-

ARI-210	Unitary Air-Conditioning Equipment
ARI-360	Commercial and Industrial Unitary Air-Conditioning Equipment

15-1.2.3 American Society for Testing and Materials (ASTM) Publications.-

A36	Structural Steel
A307	Carbon Steel Externally Threaded Standard Fasteners
B88	Seamless Copper Water Tubes
F880	Stainless Steel Screws, Type 304

15-1.2.4 Federal Communications Commission Regulations.-

Part 15, Class A Computer Devices

15-1.2.5 National Fire Protection Association (NFPA) Publications.-

70	National Electrical Code (NEC)

15-1.3 Products and Materials.-

15-1.3.1 Motors.-

15-1.3.1.1 Size and type.- Motor shall be high efficiency type, and of size and capacity indicated.

15-1.3.1.2 Over/under voltage performance.- Motor shall be designed for operation at rated output with plus or minus 10 percent voltage variation at the input terminal.

15-1.3.1.3 Nameplate data.- Motor nameplate shall indicate name of manufacturer, model and serial numbers, amperes per phase, horsepower, voltage, maximum and minimum speeds, phases, and cycles, class, and indication of starting current at rated voltage.

15-1.3.1.4 Temperature rise.- Ambient cooled motor shall be thoroughly ventilated. When running continuously at full load and full speed, temperature rise above surrounding air shall not exceed 100°F. Enclosed motor shall be rated on a 125°F rise basis.

15-1.3.1.5 Shaft length.- Motor equipped with adjustable pitch sheaves shall have an extended length driving shaft to match width of motor pulley and keyway length.

15-1.3.1.6 Acceptable manufacturer.- Motor shall be Westinghouse, General Electric, Allis-Chalmers or approved equal.

15-1.3.2 Metal wall sleeves.- Galvanized 26-gage metal. The annular opening around the sleeve shall be made watertight and covered with 1-1/2 inch by 1-1/2 inch by 1/8 inch galvanized steel angle weather-strip with corners mitered, welded, and ground smooth.

15-1.3.3 Grilles.-

15-1.3.3.1 Supply.- Two sets of individually adjustable double deflection extruded aluminum airfoil blades spaced at 3/4-inch centers with face blades parallel to the short dimension. Grille frames shall be aluminum with mitered corners. Titus Model 272FS or approved equal.

15-1.3.3.2 Return.- Fixed-blade, aluminum grille, having curved or angular break, inclined blades parallel to the long dimension. Space the blades at 3/4-inch centers. Hemmed or fully rounded leading edges. Frames with mitered corners. Titus Core #3 or approved equal.

15-1.3.4 Packaged unitary air-conditioner.- The unit shall deliver not less than the cooling capacity, heating capacity and supply air quantity indicated. Capacity ratings to be in accordance with ARI standards. Unit shall be completely factory assembled, wired, charged and tested and as a minimum shall include an evaporator coil, electric heating coil, condenser coil, evaporator fan, condenser fan, compressor, return filters, filter frame, refrigerant piping, drain pan, controls, insulated cabinet, and all associated and specified unit controls and wiring. Unit controls shall be arranged to permit remote operation and control from direct digital automatic temperature control system. Unit shall be UL listed and labeled. Cooling capacity to be certified by ARI.

15-1.3.4.1 Unit cabinet.- All components of the packaged unit shall be enclosed inside a heavy gage weatherproof steel unit casing. Entire casing and drain pan shall be factory insulated with minimum 1-inch thick, 3-lbs density internal insulation to prevent condensation and minimize noise level. Drain pan to be treated with corrosion resistant coating. Insulation shall be a standard product of the unit manufacturer. Cabinet shall be equipped with removable panels properly sized and located to permit easy access to all components including filters. Unit shall be designed for horizontal discharge and return. Cabinet shall be factory finished with two coats of baked enamel paint.

15-1.3.4.2 Refrigerant coils.- Evaporator and condenser coils shall be of non-ferrous construction with aluminum plate fins mechanically bonded to seamless copper tubes with all joints brazed. Coils shall be leak tested at 150 psig, condenser coil to be pressure tested at 420 psig, and evaporator coil pressure tested at 300 psig. Condenser coil to be amply sized to provide required subcooling. Evaporator coil to be direct expansion type with refrigerant distributor and thermal expansion valve.

15-1.3.4.3 Fans and motor.- Evaporator blower shall be double-width, double-inlet forward-curved, centrifigual, direct driven type statically and dynamically balanced, capable of operating at air quantity and external static pressure conditions indicated. Equip blower motor with adjustable pitch sheave with permanently lubricated bearings oversized to accommodate external static pressure requirements. Condenser fan shall be propeller type with direct-driven permanently lubricated motor.

15-1.3.4.4 Heating coil.- Heating coil shall be helically wound open electric type having 80 percent nickel, 20 percent chromium resistance wire insulated by ceramic bushings at all support points. Heater shall be complete with all contactors, transformers, primary and secondary limit controls, overcurrent protection, fan interlock, disconnects and other controls necessary to meet the requirements of NEC and U.L. The combination of the heater and the packaged air-conditioner shall be tested and approved as an assembly by U.L. and so marked.

15-1.3.4.5 Wiring and controls.- Controls shall be factory wired including fan and compressor contactors, high and low pressure cutouts, internal winding thermostat for compressor, control circuit transformer, non-cycling reset relay timer circuit to prevent restart of compressor more than once in five minutes, condenser fan interlocks and low ambient control. Unit shall also be equipped with a time delay relay to prevent short cycling and instantaneous compressor starts after interruption of power to compressor for any reason, whether due to safety devices, remote thermostat or commerical power failure. Low ambient control shall allow operation under ambient outdoor temperatures as low as minus 20°F and shall consist of factory wired

fan cycling head pressure control for condenser which cycles condenser fan in response to outdoor ambient temperature. The cooling system shall be protected with high/low pressure stats, loss-of-charge protection, indoor coil freeze stats, and current and temperature sensitive overload devices. Motor shall be supplied with individual overload protection. All controls shall be factory wired and installed integral with unit. Single stage cooling and single or two-stage heating controls are external to the unit and integral to the direct digital automatic temperature control system.

15-1.3.4.6 Air filters.- Air filters shall be extended area, pleated media, disposal type having medium efficiency and of the size and capacity indicated. Filter to provide nominal 30 percent efficiency when tested in accordance with ASHRAE Standard 52. Filters to be Farr 30/30 or approved equal.

15-1.3.4.7 Condensate drain.- Condensate drain line shall be type L, hard drawn copper conforming to ASTM B88, with wrought copper fittings. Provide P-trap in drain line. The end of the drain line shall be capped with 16-mesh copper screen.

15-1.3.4.8 Outside air intake.- Equip unit with a motorized damper having locking stops to admit from 0 to 25 percent outside air into return air section upstream of air filter. Damper shall close when unit is off. Protect damper with a rainproof hood fabricated of the same quality and finish metal as the unit casing and a removable corrosion resistant metallic insect screen.

15-1.3.4.9 Security provisions. Equip removable panels with a cylinder type lock appropriate for the panel design and suitable for exterior application.

15-1.3.4.9.1 Mounting brackets.- ASTM A36, hot-dipped galvanized steel angles. Bolts ASTM A307, Grade B, hot-dipped galvanized and tamperproof. Secure unit to brackets with stainless steel screws, ASTM F880, Type 304.

15-1.3.4.10 Acceptable Manufacturers.- Unit shall be the product of a manufacturer regularly engaged in production of units of type and size specified and who issues complete catalog data. Marvair, Bard, Stiles or approved equal.

15-1.3.4.11 Direct digital automatic temperature control (DDC) system.-

15-1.3.4.11.1 System description.- Provide a system consisting of a preprogrammed control panel, and input/output devices to perform the sequence of operation indicated. The DDC panel programs (software), including the future remote maintenance and monitoring system (RMMS)

functions, shall be factory installed and tested prior to shipment. All software shall be erasable programmable read only memory (EPROM) and enhanced EPROM resident to prevent loss of program on power failure.

15-1.3.4.11.2 FCC Regulations.- Computer based electronic equipment shall conform to the requirements of FCC Regulations Part 15, Section 15, 805 for Class A computer devices governing radio frequency electro-magnetic interference.

15-1.3.4.11.3 Fault tolerance.- Power supplies and system components requiring line voltage inputs shall be designed and tested to operate satisfactorily and without damage at 110 percent above and 85 percent below rated input voltage. Units shall also operate satisfactorily at ± 3 hertz variation in line frequency.

15-1.3.4.11.4 Fail-safe.- Individual application software packages shall be structured to assume a fail-safe condition upon loss of input sensors (i.e. control reverts to unoccupied cooling mode with indoor fan running). Loss of an input sensor shall result in output of a sensor failed message at the future RMMS.

15-1.3.4.11.5 Control panels.- DDC panel shall be capable of collecting and processing data for future RMMS functions. The DDC panel shall continuously scan data inputs and outputs and maintain a local memory resident data file of current values and parameters assigned to individual points. Sensor inputs shall be converted, scaled, linearized, assigned offsets as required, and be transmitted to the future RMMS in 32-bit floating point format true values along with the appropriate engineering units. Analog commands received as true values from the future RMMS shall be converted by the DDC panel to actual output values compatible with the end control devices. Any volatile memory shall be backed for a minimum of 72 hours by nickel cadmium batteries with integral automatic recharging circuit. Direct digital control panel shall contain control algorithms and sequences necessary to provide stand alone environmental control over assigned equipment as indicated. Loss of DDC equipment communication with RMMS shall in no way inhibit or result in loss of digital control of HVAC unit. Failure of any DDC shall be reported to the RMMS (where a printed record of a "no response" condition can be provided along with time of occurance.

15-1.3.4.11.6 Control loops.- All DDC loops shall be assigned EPROM (non-volatile) memory stored default values, or states, which are to be invoked on communication loss with the future RMMS. Totalizing software shall be provided at the DDC panel to allow accumulation of energy consumption data.

15-1.3.4.11.7 Input/output devices.- Input/output devices shall be provided by the manufacturer of the DDC system and shall provide the functions indicated.

15-1.3.4.11.8 Acceptable manuacturer.- Honeywell, Model R-7051A1057, or approved equal.

15-1.4 Installation.-

15-1.4.1 Packaged unitary air-conditioner.- Unit shall be securely anchored to structure to resist all loading conditions including static and dynamic loads expected under normal service as well as during transit from manufacturing facility to final destination at local site. Unit shall be supported, braced and secured as specified and as necessary to resist wind and seismic loads in accordance with the Uniform Building Code for Seismic Zone IV and 110 mph wind conditions.

15-1.4.2 Control system.- Control wiring shall be installed in conduit, neatly and parallel to building lines and surfaces. Mount the DDC control panel on an insulated base and attach panel to the wall so that the top of the panel is six feet above the floor.

15-1.4.2.1 Wiring.- Refer to Section 16-1.

15-1.4.3 Testing and adjusting packaged unitary air conditioner.- Tests shall be made with air-conditioning equipment operating at full load and filters simulated for "dirty" condition. If full load is not possible, statement of explanation shall accompany submitted test data.

15-1.4.3.1.- Air system adjustment.- Air system shall be adjusted and balanced so that return, supply and outside air quantities are as indicated and that distribution from air terminal is free from drafts, and uniform over the face of the terminal.

15-1.4.3.2.- Fan drive adjustment.- Adjustable fan drive shall be used for making final adjustments of total air quantities. Air quantities may be measured by anemometer or velometer, depending on the velocity and other conditions of flow.

15-1.4.3.3 Capacities.- Capacity of system shall be determined by operating tests of not less than four hours duration, after stable conditions have been established. Capacity shall be based on temperatures and air quantities measured during such test. Test procedures shall be in accordance with applicable portions of the SMACNA, Testing, Balancing and Adjusting of Environmental Systems, and other recognized test codes as far as field conditions permit.

15-1.4.3.4 Noise and vibration.- The unit as installed shall be free of objectionable noise and vibration. Rotating components of unit shall be mounted on suitable vibration isolators and entire unit shall be acoustically treated with sound absorbing and vibration dampening materials to assure unit sound levels do not exceed specified limits.

The maximum allowable sound level of the unit at 5-foot distance shall not exceed 55 dBA in the building interior and 75 dBA at the building exterior.

15-1.4.4 Testing control system.- Calibrate and test all connected hardware and software to ensure that the system performs in accordance with the sequence of operation indicated on the drawings.

15-1.4.5.- Furnish instruments and equipment required for tests.

15-1.5 Quality assurance.-

15-1.5.1 Submittals.-

15-1.5.1.1 Product data.- Submit catalog data for packaged unitary air-conditioner, DDC automatic temperature control equipment and accessories. Manufacturer's catalog data shall completely describe each component and device incorporated into the packaged air-conditioner and DDC system including control transformers, thermostat and relays. Catalog data shall be marked with red or other contrasting color by arrow, circling, underlining or equivalent to clearly identify each item and model.

15-1.5.1.2 Shop drawings.- Shop drawings shall include:

Control wiring diagram which shows complete interlock of wiring for input/output control devices including:

Relay holding coils;
Contactors;
Thermostats;
Transformer; and
Switches, to point of connection to factory installed wiring integral to packaged unitary air-conditioner.

Control device schedule which identifies and completely describes function and operation of each control device.

Unit component schedule and spare parts list which identifies and completely describes function of each component.

DDC control equipment installation drawings including wiring diagrams.

15-1.5.1.3 Test plan.- Submit a test plan covering the system tests proposed for start-up and commissioning of the air-conditioning and DDC automatic temperature control systems.

15-1.5.1.4 Test data general.- Obtain data requested in the attached forms.

* * * * * *

Attachment 1 of 2

UNITARY AIR-CONDITIONER

I. AIR HANDLING SECTION _____

(a) Manufacturer _____

(b) Model Number _____

(c) Serial Number _____

(d) Outdoor air temp _____ degrees FDB; _____FWB

(e) Room air temp _____ degrees FDB; _____FWB

(f) Evap coil ent air Temp _____ degrees FDB; _____FWB

(g) Evap coil lvg air Temp _____ degrees FDB; _____FWB

(h) Evap fan motor:

(1) Nameplate elec. service ____ volts, ____ phase, ___cycles

(2) Nameplate current _____amps

(3) Nameplate horsepower _____hp

(4) Measured current and voltage (at motor terminals):

L1 _____ amps; _____ volts

L2 _____ amps; _____ volts

L3 _____ amps; _____ volts

(5) Measured fan speed _____ rpm

(6) Measured supply air quantity _____ cfm

(7) Measured outside air quantity _____ cfm

(i) Electrical heating coil capacity _____ kW

Attachment 2 of 2

II. AIR-COOLED CONDENSING SECTION _____

(a) Refrigerant _____

(b) Compressor

(1) Suction pressure _____ psig

(2) Discharge pressure _____ psig

(3) High pressure cut-out _____ psig

(4) Low pressure cut-out _____ psig

(5) Nameplate elec. service ____ Volts, ____ phase, ____ cycles

(6) Nameplate current _____amps

(7) Measured current and voltage (at motor terminals)

L1 _____ amps; _____ volts

L2 _____ amps; _____ volts

L3 _____ amps; _____ volts

(C) Condenser fan motor

(1) Nameplate elec. service ____ Volts, ____ phase, ____ cycles

(2) Nameplate current _____ amps

(3) Nameplate horsepower _____ hp

(4) Measured current and voltage (at motor terminals)

L1 _____ amps; _____ volts

L2 _____ amps; _____ volts

L3 _____ amps; _____ volts

16-1 ELECTRICAL WORK

16-1.1 Scope.- Furnish and install interior and exterior electrical equipment and materials.

16-1.2 Applicable documents.- The current issues of the following documents in effect on the date of the invitation for bids form a part of this specification and are applicable to the extent specified herein.

16-1.2.1 Federal Specifications (FS).-

J-C-30	Cable and Wire, Electrical (Power, Fixed Installation)
W-B-30	Ballast, Fluorescent Lamp
W-C-375	Circuit Breakers, Molded Case; Branch Circuit and Service
W-C-586	Conduit Outlet Boxes, Bodies, and Entrance Caps, Electrical: Cast Metal - For Shore Use
W-J-800	Junction Box; Extension, Junction Box: Cover, Junction Box (Steel, Cadmium or Zinc - Coated)
W-P-115	Panel, Power Distribution
W-S-610	Splice, Conductor
QQ-W-343	Wire, Electrical Uninsulated
WW-C-566	Conduit, Metal, Flexible

16-1.2.2 Military specifications.-

MIL-P-15147	Primer and Enamel, Coal Tar
MIL-R-21931	Resin, Epoxy

16-1.2.3 National Fire Protection Association (NFPA) Publications.-

70	National Electrical Code

16-1.2.4 National Electrical Manufacturers Association (NEMA) Standards.-

MG-1	Motors and Generators
NEMA 1	General Purpose Enclosure
NEMA 3	Dusttight, Raintight and Sleet - (Ice) - Resistant Enclosure
WD1	General Purpose Wiring Devices

16-1.2.5 Underwriters Laboratories, Inc. (UL) Standards.-

UL 6	Rigid Metal Electrical Conduit
UL 50	Cabinets and Boxes
UL 98	Enclosed and Dead Front Switches
UL 514	Fittings for Conduit and Outlet Boxes

UL 542	Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 1242	Intermediate Metal Conduit

16-1.3 Products and materials.-

16-1.3.1 Heavywall steel conduit.- Heavywall zinc coated rigid steel conduit and fittings shall conform to UL 6 and UL 514. Rigid steel conduit may be used in all locations. Coated rigid steel conduit shall be used for installation below slab or grade, or underground. The conduit shall be factory coated with either .008 inch of epoxy resin in accordance with MIL-R-21931, .020 inch of polyvinyl chloride or .063 inch of coal tar enamel in accordance with MIL-P-15147, or field wrapped with .01 inch thick pipe wrapping plastic tape applied with 50 percent overlap. Fittings for use with rigid steel conduit shall be of the threaded type of the same material as the conduit. Where conduits enter boxes or cabinets without threaded hubs, double locknuts shall be used plus a phenolic insulated metallic bushing on the open end.

16-1.3.2 Intermediate steel conduit.- Intermediate zinc coated rigid steel conduit and fittings shall conform to UL 1242 and UL 514 and bear the UL label. Only factory made sweep ells shall be used. Field bends are not permitted. Fittings shall be of threaded type and of the same material as the conduit. Where conduits enter boxes or cabinets without threaded hubs, use double locknuts and phenolic insulated metallic bushing on each open end.

16-1.3.3 Flexible steel conduit.- Flexible steel conduit shall conform to FS WW-C-566. Use in 12-inch nominal lengths for terminal connections to motors or motor driven equipment, and use in short lengths for other applications as permitted by the NEC. Liquid tight flexible conduit shall be used outdoors or in wet locations. A separate ground conductor shall be provided across all flexible connections in addition to the green ground wire.

16-1.3.4 Conductors, uninsulated.- Copper in accordance with FS QQ-W-343.

16-1.3.5 Conductors, insulated.- Unless otherwise indicated, insulated conductors shall be copper with thermoplastic or thermosetting insulation, type THW, THWN, and XHHW for general use, or type THHN for use in dry locations only, all insulated for 600V in accordance with FS J-C-30. Conductors #10 AWG and smaller shall be solid, and conductors #8 AWG and larger shall be stranded. Minimum branch circuit conductor size #12 AWG. Minimum control wire size #14 AWG unless noted otherwise.

16-1.3.6 Wiring, fixture.- Copper, with thermoplastic insulation type TF, TFF, TFN or TFFN insulated for 600 volts, in accordance with FS J-C-30.

16-1.3.7 Boxes.- Boxes shall be either the cast metal hub type conforming to Federal Specification W-C-586 or shall be one piece galvanized steel type conforming to Federal Specification W-J-800. Where not sized on the drawings, boxes shall be sized in accordance with the NEC. Provide boxes in the wiring or raceway system for pulling wires, making connections, and mounting devices or fixtures. Boxes for metallic raceways shall be of the cast-metal threaded hub type in wet locations, or surface mounted on outside of exterior walls, and in hazardous areas shall be explosion proof. Boxes in other locations shall be cast metal hub type or one piece galvanized steel with cover designed for surface installation. Each box shall have the volume required by the National Electrical Code for the number of conductors in the box. Each outlet box shall have a machine screw which fits into a tapped hole in the box for the ground connection. Boxes for mounting lighting fixtures shall be not less than 4-inches square.

16-1.3.8 Wiring devices.-

16-1.3.8.1 Receptacles - general.- Receptacles shall be UL labeled and of the voltage and current rating indicated. All receptacles shall be "specification grade", side wired with two screws at each terminal. Unless noted otherwise, receptacles shall be installed 12 inches above finished floor. Receptacles shall be grounded by the installation of a green pigtail from the ground screw to the lug on the box where the green wire ground is connected. Receptacles shall have an ivory color finish.

16-1.3.8.1.1 Duplex.- NEMA WD1, Type 5-15R. Unless otherwise indicated, general purpose duplex receptacles shall be 15 amp, 125 volt, grounding type.

16-1.3.8.1.2 240 Volt.- NEMA WD1, Type 6020R. Unless otherwise indicated, 240 volt receptacles shall be 20 amp, grounding type.

16-1.3.8.1.3 Ground fault interrupting.- Receptacles shall be 15 amp, 120 volt, duplex, UL Group I, Class A. Exterior receptacles shall be mounted in waterproof cast outlet boxes with a waterproof cover.

16-1.3.8.1.4 Auxiliary generator receptacles.- Heavy duty circuit breaking type, 4 wire, 3 pole, single phase, rated 100 amps, 250-volts. DC/600 VAC. Equipped with spring door and furnished with a matching plug for the generator receptacle.

16-1.3.9 Switches, wall.- Wall switches shall be "specification grade", rated 120/277 volts, and fully rated 20 amps, A.C. only. Wiring terminals shall be of the screw type. Switches shall be the quiet operating type, and ivory colored. Not more than one switch installed in a single gang position. Unless indicated otherwise, switches shall

be installed 4 feet above finished floor. Wall switches shall bear the U.L. label.

16-1.3.9.1 Switches, safety.- Safety switches shall conform to UL 98, heavy duty, unless otherwise indicated. Switches mounted in dry locations shall be in NEMA 1 enclosures. Switches installed outdoors, or in damp or wet locations shall be mounted in NEMA 3R enclosures. Switches shall be of the voltage and current ratings indicated, and each capable of interrupting the locked rotor current of the motor. The locked rotor current is assumed to be ten times the full rated load current. The switches shall be of the quick-make, quick-break type, parts shall be mounted on insulating bases to permit replacement of any part from the front of the switch. Current-carrying parts shall be of high-conductivity copper, designed to carry rated load without excessive heating. Switch contacts shall be silver-tungsten type or plated to prevent corrosion, pitting and oxidation and to ensure suitable conductivity. Safety switches shall be lockable in either position.

16-1.3.9.2 Switch, manual transfer.- Non-fusible double throw safety switch in a NEMA 1 enclosure, 240-volts, 100 amps, single phase, double pole, factory installed solid neutral. Identify NORMAL-OFF-EMERGENCY positions. Square-D, Number DTU 223NRB, or approved equal.

16-1.3.10 Device plates.- Plates on finished walls shall be of satin finish chromium plated brass. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. The use of sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed. Device plates for telephone and intercommunication outlets shall have a 3/8 inch bushed opening in center or dome shaped grommet on the side. Where required, device plates for telephones may be more than one piece type.

16-1.3.11 Photoelectric control.- Unless otherwise indicated, the photoelectric control for exterior entrance light shall be 120 volt, 3000 watt, single pole, single throw, double break. Mount the photoelectric control in a waterproof watt hour meter socket.

16-1.3.12 Panelboards.- Panelboards shall conform to FS W-P-115 Type I, Class 1, and shall be listed by U.L. except for installations which require special panelboards to incorporate items not available as U.L. listed. All panelboards shall have a piano hinged door-in-door cover. All door hinges shall be concealed. Doors over 4 feet in height shall have auxiliary fasteners on top and bottom.

16-1.3.12.1 Gutters.- The minimum size of side wiring gutters shall be 4 inches for mains up to and including 100 amps.

16-1.3.12.2 Circuit breakers.- Quick-make, quick-break, bolt on, thermomagnetic type, conforming to FS W-C-375, and U.L. listed. Circuit breakers shall be rated for the voltage of the circuit on which they are used, and have a minimum interrupting rating of 10,000 amperes, symmetrical for branch breakers, and 22,000 amperes symmetrical for main breakers. Circuit breakers shall have a trip indicating feature. Single pole breakers shall be a full size module, and two and three pole breakers shall be sized in even multiples of a single pole breaker. Size breakers so that two single pole breakers will not be capable of fitting in a single housing. Multipole circuit breakers shall have an internal common trip mechanism. Devices with an adjustable magnetic trip shall be factory set to the "low" value. Circuit breakers and the panelboards in which the breakers are installed shall be made by the same manufacturer. Self-enclosed circuit breakers shall be mounted in NEMA type 1 enclosures with trip rating, voltage rating and number of poles as indicated.

16-1.3.12.3 Bus bars.- Buses shall be copper. Bus capacity shall be as indicated. Circuit breaker current-carrying connections to bus shall be of the bolted type, factory assembled. Stab-in types are not acceptable. Bus bar connections to branch circuit breakers shall be of the sequence phase type. Connect branch circuits to the individual circuit breakers as indicated. The neutral bus shall be insulated from panelboards. Panelboards shall have an uninsulated ground bus bolted to the cabinet, adequate in size to accommodate present and future equipment grounding conductors. Isolate ground bus from the neutral bus except at the service disconnect means. Where provisions for, future breakers are indicated, the panelboard shall be equipped with bus connections for future breaker installation.

16-1.3.13 Cabinets.- Cabinets for the telephone and signal systems shall be constructed of code gage zinc coated sheet steel, and shall meet the requirements of U.L. Standard 50. Cabinets shall be constructed with interior dimensions not less than those indicated. Provide a 3/8-inch plywood backboard.

16-1.3.14 Motors.- Motors shall conform to NEMA MG-1 minimum insulation Class B, squirrel cage type, having normal starting-torque and low-starting-current characteristics. Motors shall be of sufficient size for the duty to be performed, and shall not exceed the full-load rating when the driven equipment is operating at specified capacity. Motors shall be rated for the voltage of the connected system. Unless otherwise indicated, motors shall have open frames, and continuous-duty classifications. The motor ratings indicated are for guidance only and do not limit the equipment size.

Provide each motor with a means of disconnecting and a manually operable switch as indicated or when required by the National Electrical Code. Enclose safety switches as specified. Switches shall disconnect all ungrounded conductors.

16-1.3.15 Fuses.- Fuses shall have a voltage rating not less than the circuit voltage. Cartridge fuses shall have an interrupting rating as indicated, but if not indicated shall be not less than 100,000 amps when used in branch and distribution circuits, and not less than 200,000 amps when used in a service entrance switch.

16-1.3.16 Surge arrestor.- 120/240-volts, single phase, 3-wire, (centerground) 60-hertz, voltage range 90-136 VRMS phase to neutral, unlimited power rating, instantaneous response time. No delay continuous conduction, extreme duty discharge capacity 65,000 amps. Minimum life 2000 operations, temperature range minus 40°F to plus 140°F. Lightning Protection Corporation (L.P.C.) Catalog Number 20206-7 or approved equal.

16-1.3.17 Lighting fixtures.-

16-1.3.17.1 General.- Lamps and lighting fixtures shall be of the types indicated, U.L. approved and bear the U.L. label. Incandescent lamps shall be rated for 120 volts.

16-1.3.17.2 Fluorescent fixtures.- Fixture lenses shall be the prismatic type, made of virgin acrylic. Lamps shall be rapid start, cool white. Ballasts shall be Class P, rapid start, high power factor type conforming to FS W-B-30. Provide ballasts with choke type radio frequency interference suppressors. Ballasts shall bear the CBM/ETL label. Lampholders shall have silver plated contacts, and conform to UL-542.

16-1.3.17.3 Incandescent fixtures.- Incandescent fixtures shall be provided for exterior lighting, type as indicated. Fixtures shall bear the U.L. label.

16-1.3.18 Grounding electrodes and conductor.- The grounding electrode conductor shall be bare copper. The rods shall be 3/4 inch diameter by 10 feet long copper-clad steel and of the sectional type.

16-1.3.19 Splices.- Solderless connectors for splices shall conform to FS W-S-610.

16-1.4 Installation.-

16-1.4.1 Wiring.-

16-1.4.1.1 General.- In the single phase system specified, not more than one of each of the ungrounded conductors shall be run with a common neutral. Neutral conductors shall extend from the neutral bus in the device where the active conductors originate. Device terminals for connection of more than one conductor shall be specifically designed for that purpose.

16-1.4.1.2 Raceways.- Minimum conduit size shall be 3/4 inch, but may be 1/2 inch for exposed control wiring. Each run shall be complete, fished, and swabbed before conductors are installed. Cap ends of conduit systems not terminated in boxes or cabinets. Exposed raceways shall be installed parallel to or at right angles with the lines of the structure. A pull wire shall be installed in empty tubing and conduit systems in which wiring is to be installed by other trades. The pull wire shall be No. 14 AWG zinc coated steel, or plastic with a minimum 200 pound tensile strength. Ten inches of slack shall be left at each end of the pull wire. Sections of raceways which pass through damp, concealed or underground locations shall be of a type specified for such locations, and extending a minimum of 12 inches beyond the damp, concealed, or underground area.

Where conduit has to be cut in the field, cut square using a hand or power hacksaw or approved pipe cutter using cutting knives. The cut ends of the field-cut conduit shall be reamed to remove burrs and sharp edges. Where threads have to be cut on conduit, the threads shall have the same effective length and the same thread dimensions and taper as specified for factory cut threads on conduit.

16-1.4.1.2.1 Raceway support systems.- Raceways shall be securely supported and fastened in place at intervals of not more than 10 feet and within 3 feet of each outlet, junction box, cabinet or fitting, with wall brackets. Fastenings shall be by wood screws, nails or screw-type nails to wood; and by expansion-bolts on concrete.

16-1.4.2 Boxes.- Cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Separate boxes shall be provided for flush or recessed fixtures where required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes. Boxes and supports shall be fastened to wood with wood screws, nails, or screw-type nails of equal holding strength.

16-1.4.3 Splicing.- Splices shall be made only at outlets, junction boxes, or accessible raceways. Use wire nuts to splice conductors sized #10 AWG and smaller, and compression connectors to splice conductors #8 AWG and larger. Splices shall be taped with electrical insulating tape in a manner which makes their insulation equal to the insulation on the conductors.

16-1.4.4 Device plates.- Plates of the one piece type shall be provided for all outlets and fittings to suit the devices installed. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plates shall be installed with an alignment tolerance of 1/16 inch.

16-1.4.5 Photoelectric control.- Install on the building exterior, faced in a northerly direction.

16-1.4.6 Service equipment.-

16-1.4.6.1 Power, general.- Service entrance equipment shall be in accordance with the regulations of the local utility providing service and the NEC. The power service entering the building shall have a clockwise phase rotation throughout the building.

16-1.4.6.1.1 Conduits.- Service entrance conduits shall be installed as indicated and shall be heavywall zinc coated rigid steel. Underground service entrance conduits shall be installed a minimum of 2 feet below finished grade.

16-1.4.6.2 Disconnect switch.- Switches used for service entrance disconnecting shall be fused disconnecting type and U.L. approved and labeled for use as service equipment.

16-1.4.6.3 Surge arrestor.- Power surge arrester shall be installed adjacent to (within one foot) and on the line side of the manual transfer switch as indicated. Connect the arrestor as recommended by the manufacturer.

16-1.4.6.4 Ground fault interrupting receptacles.- Install ground fault interrupting receptacles at exterior outlets for general purpose 120 volt usage, and in other locations as indicated.

16-1.4.6.5 Auxiliary generator receptacle.- Design for exterior mounting 3 feet and 6 inches above the finish floor line.

16-1.4.7 Panelboards.- Panelboards shall be mounted so that the height to the top of the panelboard shall be 6 feet and 9 inches above the finished floor level. Directories shall be typed to indicate the load served by each circuit and mounted in a holder with protective covering. Arrange the directory so that the typed entries simulate the circuit breaker positions in the panelboard.

16-1.4.8 Cabinets.- Cabinets shall be mounted so that the height to the top of the cabinet is 6 feet and 9 inches above finished floor level.

16-1.4.9 Fuses.- A complete set of fuses shall be installed and one set of spares shall be furnished for each fusible device. Time and current tripping characteristics of fuses serving motors or connected in series with circuit breakers shall be coordinated for the proper operation.

16-1.4.10 Grounding.-

16-1.4.10.1 General.- The grounding system shall be installed as indicated. The National Electrical Code shall govern, except where otherwise indicated.

16-1.4.10.2 Connecting grounding systems.- Ground rods shall be interconnected by means of a buried, bare, No. 4/0 AWG copper cable. The cable shall be buried at least 2 feet below grade level or as indicated. Connections to the ground rods shall be made by exothermic welding or an approved type of high compression fitting except in access wells. Connections in access wells shall be made by means of UL approved and labeled connectors. The interconnecting cable shall close on itself forming a complete loop with the ends exothermically welded or connected with an approved pressure connector in an access well. The grounding electrode conductor for the electric service, sized in accordance with the NEC requirement shall be connected to the earth electrode system with a UL approved and labeled connector in an access well. Underground metallic pipes shall be connected to the earth electrode system by means of No. 2 AWG copper cable. Where routed underground, the interconnecting cables shall be bare. All connections shall be exothermically welded except where such welding could be hazardous. In these cases, bolted connections utilizing UL approved connectors shall be made. Bonding jumpers shall be sized to meet or exceed the NEC.

16-1.4.10.3 Access well.- The access well shall be provided with a removable cover which can be locked. The access well shall provide space for testing the earth electrode system, connecting multipoint ground cables and future ground cables to the earth electrode system.

16-1.4.10.4 Equipment grounding.- All electrical equipment, including light fixtures and receptacles shall be grounded by means of a separate green insulated ground wire (minimum of #12 AWG) routed within the raceway. The ground conductor shall be connected to the power panel or lighting panel equipment ground bus. All metallic non-current carrying parts of electronic equipment shall be grounded to this equipment grounding system.

16-1.4.10.5 Primary power ground.- Primary power shall be 1 phase, 3 wire, with one wire the neutral. At the service entrance safety switch, the neutral wire shall connect directly to the grounding grid. AC power distributed from the power distribution panel shall be 3 wire with the neutral isolated from ground.

16-1.4.10.6 Protection.- Mechanical protection shall be provided for all cables in the ground system where they may be subject to damage. Protection shall be provided by conduit bonded to the cable at each end.

16-1.4.10.7 Raceway ground.- Every component of metallic conduit runs such as individual sections, couplings, line fittings, pull boxes, junction boxes, and outlet boxes shall be bonded to the ground system. Bonding jumpers shall be sized to meet or exceed the National Electrical Code requirements.

Conduit brackets shall be securely bonded to the conduit and to the structure to which they are attached. Wireways shall be bonded at each joint with a #6 AWG ground conductor.

16-1.4.10.8 Electronic ground conductor.- Electronic ground system is indicated on drawings. Ground conductor shall be separate from equipment ground conductor, color shall be green with yellow tracer. Connections of electronic equipment to the electronic ground and electronic ground to the counterpoise will be done by others.

16-1.4.11 Identification.-

16-1.4.11.1 Nameplates.- Each of the following types of equipment shall be identified with a name plate which shows the functional name of the unit, voltage utilized, phase as applicable, and any other pertinent information. Switches for local lighting shall not be identified.

Motor controllers
Panel boards
Switches
Generator receptacle assembly
AC Power surge arrestor

Additional units of equipment shall also be identified if called for in the plans. Name plates shall be non-ferrous metal or rigid plastic, stamped, embossed or engraved with 3/8 inch minimum height lettering or numerals. The plates shall be secured to the equipment with a minimum of two screws.

16-1.4.11.2 Color coding.- Branch circuit and feeder conductors shall be color coded. The color coding shall be continuous throughout the facility on each phase conductor to its point of utilization so that the conductor phase connection is readily identifiable in any part of the installation. The equipment grounding conductor shall be as specified. Neutral conductors shall be continuous white. Where color coding is not available in the larger size conductors, the conductors shall be color coded by use of color coded tape, half lapped for a minimum length of 3 inches. Where conductors are color coded in this manner, they shall be color coded in junction and pull boxes, accessible raceways, panelboards, outlets and switches, as well as at terminations. Conductors in accessible raceways shall be coded in such manner that by removing or opening any cover, the coding will be visible.

Phase conductors shall be color coded as follows:

Single Phase

120/208 or 240 Volts

Line A - Black
Line B - Red

16-1.4.11.3 Conductor markers.- In addition to color coding, all line, phase, and neutral conductors shall be identified by plastic-coated, self sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved by the COR. Panel and circuit numbers shall be identified. Conductor identification shall be provided at terminations, and in junction boxes through which these conductors pass. Control circuit conductor identification shall be made by heat shrink tubing, permanently attached stamped metal foil markers, or equivalent means as approved by the COR. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved shop drawings. Hand lettering or marking is not acceptable.

16-1.5 Quality assurance.-

16-1.5.1 Submittals.- Conform to the procedures specified.

16-1.5.1.1 List of materials and equipment.- Submit complete list of materials and equipment.

This list shall include manufacturer's style or catalog numbers. Catalog cuts or other descriptive data shall be furnished when required by the COR.

Partial lists submitted from time to time are not considered as fulfilling this requirement.

16-1.5.1.2 Shop drawings.- Shop drawings shall be submitted for materials and equipment not completely identifiable by information submitted in the materials and equipment lists.

16-1.5.2 Tests.-

16-1.5.2.1 General.- Furnish instruments, materials and labor necessary to perform the following tests. Perform tests in the presence of the COR.

16-1.5.2.2 Insulation resistance.- Feeders and branch circuits shall have their insulation tested after installation, but before connection to fixtures or appliances. Motors shall be tested for grounds or short circuits after installation but before start-up. Conductors shall be free from short circuits and grounds, and a minimum insulation resistance phase-to-phase and phase-to-ground shall be 10 megohms measured with a 500-volt insulation resistance tester.

16-1.5.2.3 Neutral isolation.- After installation of branch circuits, the neutral in the service entrance switch shall be tested for isolation from ground with an ohmmeter set on its RX1 scale. The incoming neutral shall be temporarily disconnected to accomplish this test. Any contact between the neutral and ground (other than at the service entrance switch) is a possible cause of noise in electronic equipment and shall be corrected.

16-1.5.2.4 Earth resistance.- Submit in writing upon completion of the project the measured ground resistance of each ground rod indicating the location of the rod, resistance to ground, and the soil conditions at the time the measurements were made. After ground rods are installed, tie them together with the counterpoise and the resistance to ground of the entire system shall be measured before and after the connection of the earth resistance tester. The maximum ground resistance shall be 10 ohms. Where additional ground rods are required to achieve the specified resistance, the COR shall be notified before proceeding with additional work. The Earth Resistance Test equipment and test procedures shall be by the Biddle Manufacturing Company or equal.

16-1.5.2.5 Operating.- After the interior wiring system installation is completed, and at such time as the COR directs, conduct an operating test. The equipment shall operate in accordance with the requirements of the specification.

* * * * *

MARTIN MARIETTA

475 SCHOOL STREET, S.W. WASHINGTON, D.C. 20024

NI TRANSMITTAL LETTER

FROM: Gene White, DC5120 DATE: June 21, 1988

TO: W. Donald Swinney, APS-120

ATTENTION:

TASK TITLE: Specifications for Construction of Small Precast Concrete Building for Electronic Equipment

ATTACHED ARE THE FOLLOWING ITEMS:

- [ ] DRAWING ORIGINALS
- [ ] DRAWING REPRODUCIBLES
- [ ] DRAWING PRINTS
- [x] SPECIFICATIONS
- [ ] DESIGN DATA HANDBOOK
- [ ] OTHER

No. Copies	No. Sheets	DESCRIPTION
1	Set	Camera Ready Specifications
1		WANG Disk containing Specifications

THESE ARE TRANSMITTED FOR YOUR:

- [ ] 50% REVIEW
- [ ] 90% REVIEW
- [ ] SIGNATURE
- [ ] USE
- [ ] OTHER

REMARKS: Per your request of Parsons.

SIGNED: Gene White

cc: R. Kiss